Report for 2003TX95B: Measuring Infiltration Using a Rainfall Simulator to Comparing Shrub and Water Interactions of Brush Species

- Conference Proceedings:
  - Porter, S., Munster, C. L. "Development of a Portable Rainfall Simulator for Large Plot Brush Control Hydrology Studies." In Proceedings of the International Meeting of the American Society of Agriculutral Engineers in Las Vegas, NV. Riviera Casino during July 27-30, 2003.
  - Porter, S., Munster, C. L. "Rainfall Simulation Study of a Hillslope Covered in Dense Juniper." In Proceedings at the 2003 American Geophysical Union. San Freancisco, California at the Moscone Center West during December 8-12, 2003. The poster highlighted preliminary results of a filed study at Honey Creek State Natural area in Bulverde, TX.

Report Follows

Progress Report to Texas Water Resources Institute

This report is to update the Texas Water Resources Institute about progress made on research funded by the institute through a USGS grant awarded in 2003. The grant was awarded for Measuring Infiltration using a Rainfall Simulator for Comparing Shrub and Water Interactions of Brush Species**.** *This progress report will present discussion on the following issues: Research – related activities, Insights on information learned during the research, Experiences of shared information related to the project, Progress made in expanding funds, Progress on graduate degree, and Related activities of the committee chairman as a result of this grant.*

Research Related Activities

Funding from other Texas Water Resources Institute grants in the past have allowed the rainfall simulator to be developed and constructed. Money was used to support salaries for student workers, purchase necessary materials and equipment, and was used to purchase an equipment trailer. Once the simulator was constructed and tested, it was set up at the Texas Agricultural Experiment Station in Sonora, TX. This initial study took place from October 2002 to June 2003. The rainfall simulator was installed around a 3 m by 12 m plot which was covered with heavy brush. The plot was instrumented to collect information such as soil moisture, surface runoff, and stemflow within trees. Unique to this site was the addition of a trench at the base (down slope) of the plot. The trench assisted in visually monitoring and quantifying lateral subsurface flow within this system. Artificial rain events were applied to the plot at varied intensity and duration (4 in per hour for 45 minutes to 1 in per hour for seven hours). At the conclusion of the initial simulations, the brush was removed from the plot, and simulations commenced. An "open canopy," or grass plot was installed in close proximity to the brush plot to be used as a control in the experiment.

At the conclusion of work at the Sonora Experiment Station, the rainfall simulator was relocated to Honey Creek State Natural Area, close to Bulverde, TX. There the simulator was installed on a 7 m by 14 m plot containing heavy brush. Knowledge gained from tests conducted in Sonora allowed the research team to scale up the plot studies without compromising the integrity of the basic design on the rainfall simulator. To accomplish simulating rainfall on this larger plot size, the unit would require slight modifications to conserve water while applying water on the area.

The plot at Honey Creek was instrumented similarly to the plot at Sonora. The brush species was notably different there when compared to Sonora, which made certain instrumentation difficult. The Honey Creek site had a larger trench dug at the base of the plot, again to visually observe and quantify subsurface flow. Similar intensities of water were applied to this plot site.

Figure 1. Rainfall Simulator Deployed at Honey Creek State Natural Area

This study is currently in progress. A second grass plot is being installed at the area and experiments will start in the near future. The brush on the original Honey Creek plot will be removed, and simulations will resume once the area is cleared. Future applications of the rainfall simulator include setting the unit above a cave and quantifying recharge through the soil and rock structures. This study will be conducted at Camp Bullis in San Antonio, TX, and will commence in the near future.

Insights on Information Learned

The addition of the trench to the research site at the base of the plot has proved to be invaluable. We are able to get a basic idea of lateral subsurface flow from the plot. This flux can be related back to the amount of water that was applied to the plot of exact dimension. An appreciable amount of water applied at the surface reappears as lateral subsurface flow in the trench (as much as 10%). A dye tracer test was conducted in conjunction with the Edwards Aquifer Authority. The results of this test are still being analyzed. Preliminary information from this study suggests that dye that was applied at the base of a tree 7 m from the trench appeared as subsurface flow from the trench face. This suggests that a relationship may exist between the roots of brush species and potential water recharge.

Figure 2. Water Sampling During a Dye Tracer Test at Honey Creek State Natural Area

Experiences of Shared Information

During the previous year, we gave a presentation on a conference paper at the International Meeting of the American Society of Agricultural Engineers in Las Vegas, NV. The conference was held at the Riviera Casino during July 27 – 30, 2003. The presentation covered the paper written for this international meeting entitled, *Development of a Portable Rainfall Simulator for Large Plot Brush Control Hydrology Studies.* This paper discussed the development of the simulator and knowledge learned from a field campaign using the unit at the Texas Agricultural Experiment Station in Sonora, TX. The conference was attended by Agricultural, Biological, Forestry, and Food Engineers world wide.

We also gave a poster presentation at the Fall Meeting of the American Geophysical Union. This meeting was held in San Francisco, California at the Moscone Center West during December 8 – 12, 2003. The poster was titled *Rainfall Simulation Study of a Hillslope Covered in Dense Juniper.* The poster highlighted preliminary results of a field study at Honey Creek State Natural area in Bulverde, TX.

The main rainfall simulation study to date is established at the Honey Creek State Natural Area. The current research site is a collaborative effort of researchers from the Department of Biological and Agricultural Engineering and Department of Rangeland Ecology Management at Texas A&M University, from the Texas Agricultural Experiment Station in Uvalde, TX, and researchers from the University of Texas and Duke University. Many distinguished guests to the research site, including world – renowned scientists from many universities. In addition, many agencies that support this research have brought their own employees and their colleagues.

Progress Made in Expanding Funds

Money from this generous grant is still available to purchase additional research equipment. We have been very fortunate to have the cooperation of many entities that can provide services and support at no cost. Texas Parks and Wildlife has allowed us access to their land to conduct research. Bexar Met Water District is providing water essential to this research.

Progress on Graduate Degree

The majority of my research has comprised field work at Sonora and Bulverde, TX. My thesis is in the process and I am planning to defend it in time to graduate in May 2004. I am finished with the class requirements of my degree program.

Related Activities of Chairman

Information learned from initial tests conducted with the rainfall simulator have allowed collaborators of this research project to secure additional funding to continue this research. As mentioned, future work will soon commence at Camp Bullis. This project will add valuable insight to the overall picture of water recharge, since actual recharge will be documented within a cave that exists below the research plot. Future plans are to take this research to the next scale by installing a series of rainfall simulators at the hillslope scale (rather than just the large plot scale) in an effort to look at watershed issues of brush control.